Space Weather Technical Forecast

Issued on Sunday, 22 October 2023 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Weak CME arrivals possible on Day 1 (22 Oct), with HSS arrivals later in the period, giving a slight chance of G1/Minor Storm intervals.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity as recorded at GOES16 has been Low over the past 24 hours, with just one low level C-class flare. There are currently five sunspot regions on the visible disc, all of which are relatively small and simple. AR3469 in the northwest and AR3470 in the northeast have both started to fade a little.
No Earth directed CMEs have been seen in coronagraph imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, may be showing signs of some very weak CME enhancement. The wind speed has been at ambient levels, between 280-330 km/s. The density has been predominantly average or below. The IMF has been mostly weak, but with occasional moderate peaks. The Bz has been mostly weakly southward directed. The phi angle has been variable. Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels.
GOES16 high energy (greater than 2MeV) electron flux was predominantly at background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 22/0000 UTC was 1.16e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to remain Low or Very Low, with an ongoing chance of isolated C-Class flares. There is a very slight chance of M-flares.

Solar Wind / Geomagnetic Activity: There have been two Earth-directed CMEs in the forecast, which are now late and considered likely to have mostly missed Earth. A very minor recent enhancement in the solar wind may be the edge of this feature, which could have combined into one CME. A third very slow CME is expected to pass to the south of Earth later on Day 4 (25 Oct) and may glance, but is more likely to miss. There is also the potential for HSS enhancements, from CH63/- on Day 2 or Day 3 (23-24 Oct), then from CH64/+ perhaps later on Day 4 (25 Oct).
Geomagnetic activity is expected to be predominantly Quiet to Unsettled (Kp 0-3). There is a chance of Active (Kp 4) intervals and a slight chance of a G1/Minor Storm (Kp 5) in association with CME and HSS effects, most likely on Day 1 with any CME arrival and Day 4 should the HSS from CH64/+ arrive.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to persist at background levels.
High energy electron flux (greater than 2MeV) is expected to be at background levels, perhaps rising later depending on the strength of any CME or HSS enhancements. The associated 24-hour electron fluence is expected to remain below Active (1e8 integrated pfu).

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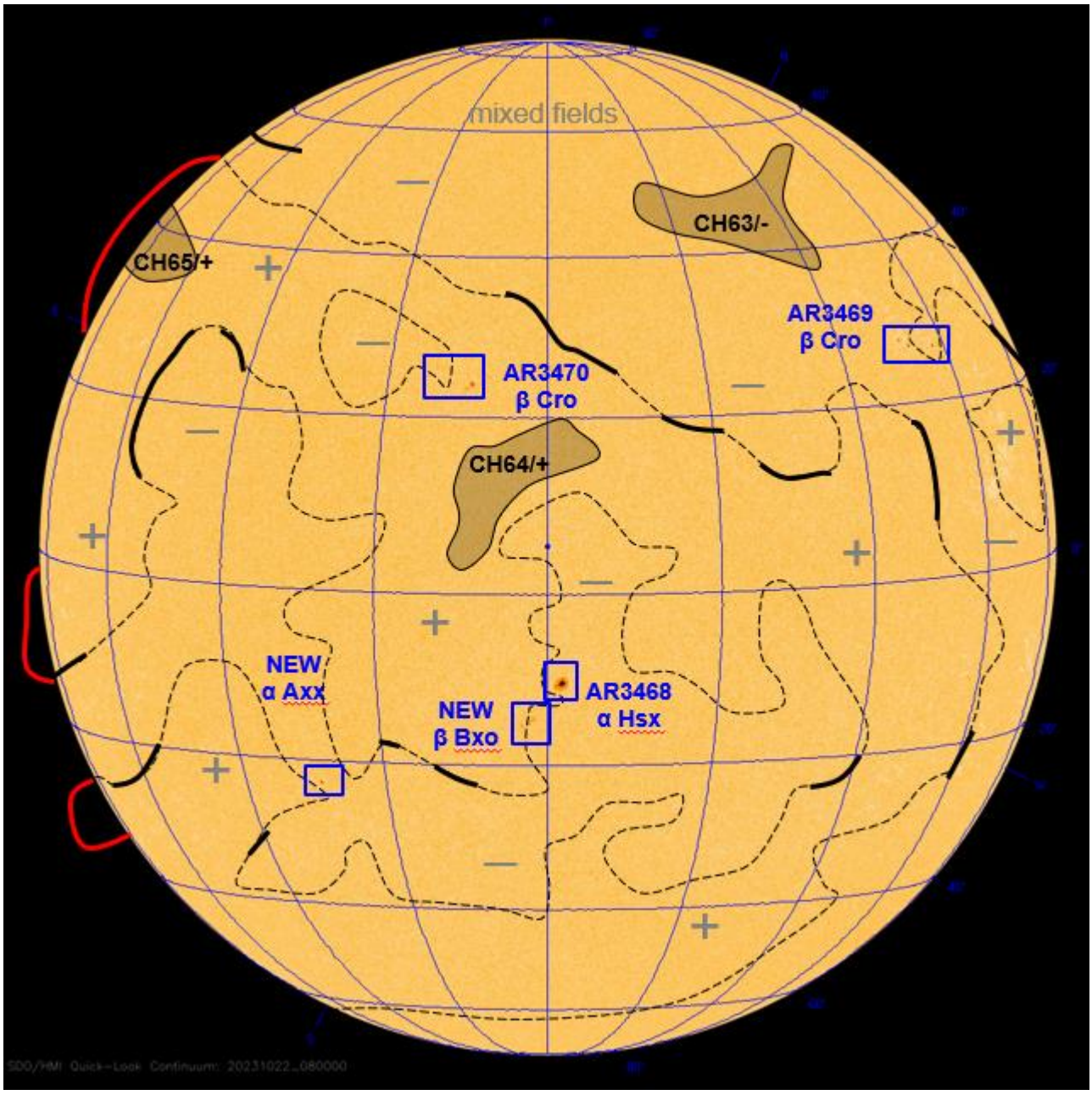
Figure 1. Solar Analysis Valid 22/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There have been two Earth-directed CMEs in the forecast, which are now late and considered likely to have mostly missed Earth. A very minor recent enhancement in the solar wind may be the edge of this feature, which could have combined into one CME. A third very slow CME is expected to pass to the south of Earth later on Day 4 (25 Oct) and may glance, but is more likely to miss.

There is also the potential for some enhancement to the solar winds from Day 2 (23 Oct) or Day 3 (24 Oct) associated with a HSS from CH63/-. However, the combination of the position of this coronal hole feature on the disc and its negative polarity would signify only minor enhancement with winds potentially increasing to elevated levels. A further HSS from CH64/+ could connect late on Day 4 (25 Oct), although it is more likely after the end of this period. This is a positive polarity CH and may give a greater risk of geomagnetic enhancement at this time of year.

Geomagnetic activity is expected to be predominantly Quiet to Unsettled (Kp 0-3). There is a chance of Active (Kp 4) intervals and a slight chance of a G1/Minor Storm (Kp 5) in association with CME and HSS effects, most likely on Day 1 with any CME arrival and Day 4 should the HSS from CH64/+ arrive.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/1430	Partial	Filament	SW	420 km/s	Early 22 October	Most likely to have missed.
18/1132	Partial	Filament	SE	610 km/s	Early 22 October	Most likely to have missed.
21/1545	Partial	Filament	SW	250 km/s	Late 25 or early 26 October	Glancing blow possible, more likely to miss.

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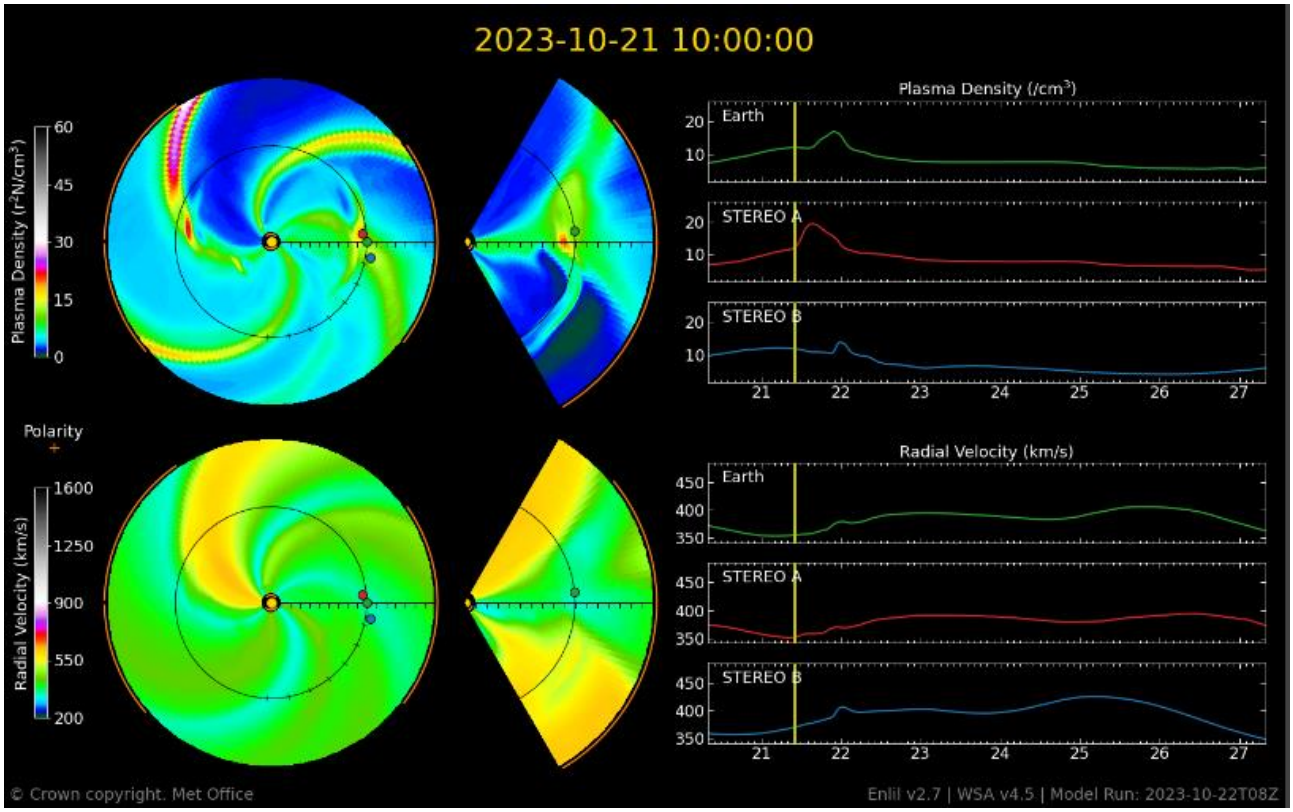
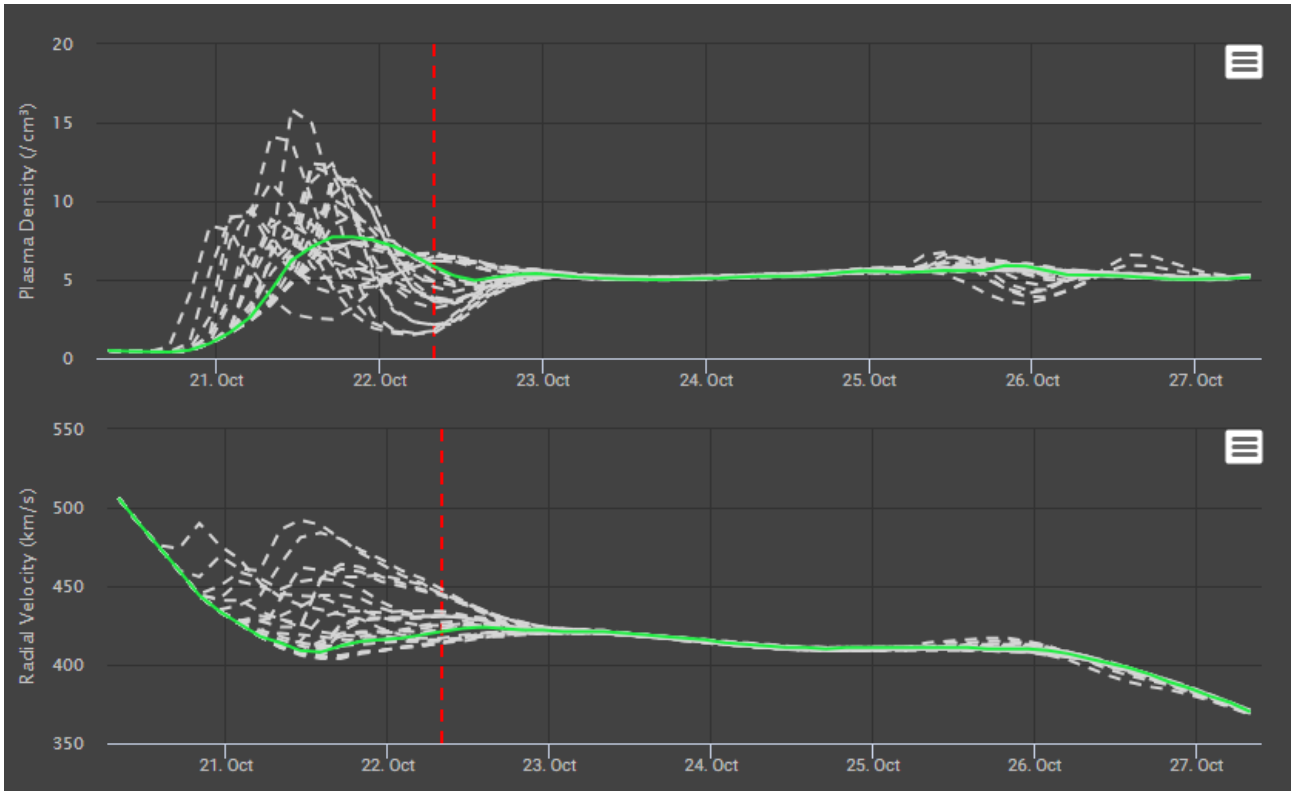
Figure 2: MOSWOC Enlil and ensemble, showing the possible glancing CME interaction earlier today, which is likely to have mostly missed Earth.





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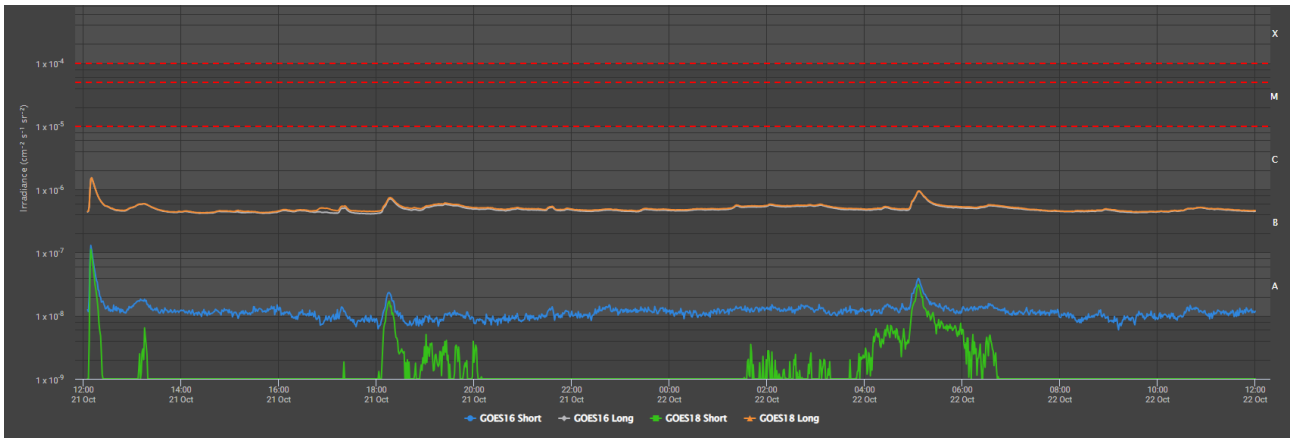
Radio Blackouts - X-Ray Flares:
There are currently five sunspot regions on the visible solar disc, all of which are small and simple. AR3469 in the northwest and AR3470 in the northeast have both started to fade a little. There are hints in AIA-094 imagery that a new region may be approaching the northeast limb in the next day or so, but in the absence of activity from over the limb this will be assessed when it becomes visible on the disc. In the meantime a very slight uptick in probability has been included from Day 2 (23 Oct) to reflect this risk.

Activity is likely to remain Low or Very Low with a chance of further isolated C-class flares. There is just a very slight chance of an isolated low level M-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray trace at GOES 16 and 18, showing very little activity.



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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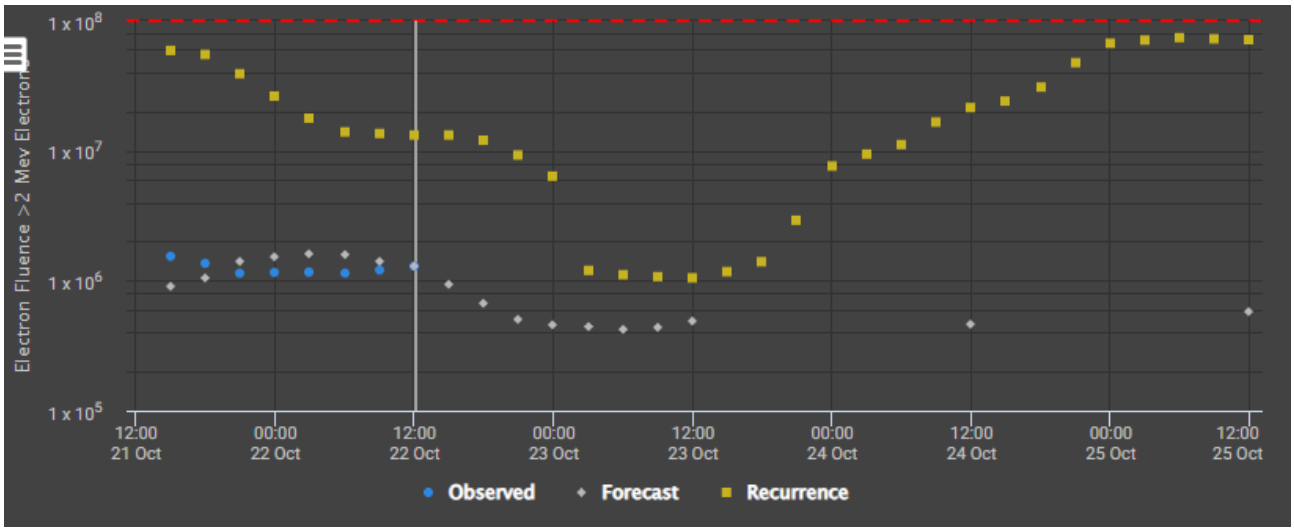
High Energy Electrons Event (≥ 2MeV):
Electron flux observed by GOES16 at GEO is currently at background levels. Solar wind enhancements are possible through the coming days, with the reducing possibility of weak CME arrivals on Day 1 (22 Oct) and potential HSS influence from Day 2 (23 Oct) onwards. There is low confidence in detail, but in the short term these are likely to suppress electron flux levels, before a potential rise later in the period.

The associated 24-hour fluence is expected to remain below the Active threshold, as supported by MOSWOC REFM output. However, the model does not take into account any potential CME arrivals. Fluence levels may rise towards the end of the period, but with low confidence at this stage.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM showing a steady trend through the next three days.



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